

## 17. Carbon and Other Greenhouse Gas Emissions

### 17.1 Introduction

- 17.1.1 This chapter of the Environmental Statement (ES) assesses the likely significant effects of the Proposed Development with regards to Carbon and Other Greenhouse Gas (GHG) emissions on the global climate.
- 17.1.2 The chapter should be read in conjunction with **Chapter 2: Description of the Proposed Development**.
- 17.1.3 The vulnerability of the Proposed Development to climate change is considered in **Chapter 2: Description of the Proposed Development**.
- 17.1.4 Likely significant effects of the combined impacts of the Proposed Development and climate change on environmental receptors are considered in **Chapter 9: Landscape and Visual, Chapter 10: Land Quality, Chapter 11: Biodiversity, Chapter 12: Surface Water and Flood Risk, and Chapter 13: Groundwater**.
- 17.1.5 A summary of the findings from this chapter and the climate change aspects of each of the above chapters is provided in **Chapter 19: Summary of Significant Effects and Mitigation**.

### 17.2 Limitations of this assessment

- 17.2.1 The limitations relating to carbon and other GHGs that affect the robustness of the assessment of the likely significant effects of the Proposed Development are:
- In the assessment, carbon dioxide (CO<sub>2</sub>) & carbon dioxide equivalent<sup>1</sup> (CO<sub>2</sub>e) emissions have been calculated for different sources based on convention. Given that reporting in CO<sub>2</sub> is the standard practice for aviation emissions, the emissions reported are still deemed representative of a worst-case scenario;
  - Heavy Goods Vehicle (HGV) deliveries to the application site during construction have been estimated assuming trips originate within a distance of 150km from the Proposed Development, which includes cities such as London, Birmingham and Exeter. This represents a worst-case scenario, with many trips likely to be from more local origins e.g. Bristol and surrounding areas, which would therefore emit less GHGs; and
  - There is little publicly-available information available for energy used during construction (e.g. from construction plant) and there is no information from previous site construction activities at Bristol Airport available. Therefore, an estimation has been made based on a recent case study of a complex building that is a comparable proxy for construction activities emissions at the Proposed Development<sup>2</sup>. This approximation has been verified against older information from the UK construction industry and so is deemed an appropriate source to use.

<sup>1</sup> Carbon dioxide equivalent (CO<sub>2</sub>e) is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO<sub>2</sub>e represents the amount of CO<sub>2</sub> which would have the equivalent global warming impact.

<sup>2</sup> Seo, M et al. (2016). On-Site Measurements of CO<sub>2</sub> Emissions during the Construction Phase of a Building Complex. *Energies* 2016, 9(599), pp. 10-12.

## 17.3 Relevant legislation, planning policy and technical guidance

### Legislative context

17.3.1 The following legislation is relevant to the assessment of the effects on carbon and other GHG receptors:

- *The Climate Change Act 2008*<sup>3</sup>: This commits the UK to reduce its net GHG emissions by 80% below 1990 levels by 2050 and requires the Government to establish 5-year Carbon Budgets<sup>4</sup>. Emissions arising from international aviation and international shipping were not included in the Carbon Budgets (and the 2050 target) when the Climate Change Act was enacted. In 2011, the UK government issued its Carbon Plan, which sets out how the UK will achieve decarbonisation within the framework of UK energy policy and make the transition to a low carbon economy. The most recent Carbon Budget, the fifth, was released in 2016 and describes the budget for the period 2028-2032.

Total GHG emissions reductions for the UK as a whole have met the requirements of the Second Carbon Budget<sup>5</sup>. However, most of the reduction has come in the power, industry and waste sectors, with transport increasing since 2007 largely as a result of rising demand for travel and a slowing of progress in improving the efficiency of vehicles<sup>6</sup>. The UK Carbon Budgets include domestic aviation, but not international aviation. Carbon Budgets for a range of sectors have been produced under the Fifth Carbon Budget;

- *Environmental Impact Assessment (EIA) Directive 2014*<sup>7</sup>: The EIA Directive 2014 sets out the rationale for incorporating climate change into the EIA process. Paragraph 13 reads: "*Climate change will continue to cause damage to the environment and compromise economic development. In this regard, it is appropriate to assess the impact of projects on climate (for example greenhouse gas emissions) and their vulnerability to climate change.*"; and
- *The Town and Country Planning (Environmental Impact Assessment) Regulations 2017*<sup>8</sup>: This is the transposition of the *EIA Directive 2014* into UK law. Schedule 4, Regulation 18(3) (Information for Inclusion in Environmental Statements) refers to 'climate' in the following way: "*A description of the factors specified in regulation 4(2) likely to be significantly affected by the development... climate (for example greenhouse gas emissions, impacts relevant to adaptation)*", and: "*A description of the likely significant effects of the development on the environment resulting from, inter alia... the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*"; therefore, signalling that both the impact of climate change on the development (including environmental receptors) and the impact of the development on climate change, are to be considered. The Regulations set out the emissions sources to be considered in a GHG assessment.

<sup>3</sup> The UK Government (2008). Climate Change Act 2008, [online]. Available at:

[https://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga\\_20080027\\_en.pdf](https://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf) [Checked 12/07/2018].

<sup>4</sup> Department for Business, Energy and Industrial Strategy (2016). Guidance: Carbon Budgets, [online]. Available at:

<https://www.gov.uk/guidance/carbon-budgets> [Checked 10/10/2018].

<sup>5</sup> BEIS (2018). 2016 UK greenhouse gas emissions: final figures – statistical summary, [online]. Available at:

<https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2016> [Checked 10/10/2018].

<sup>6</sup> CCC (2017). Meeting Carbon Budgets: Closing the policy gap, [online]. Available at: <https://www.theccc.org.uk/wp-content/uploads/2017/06/2017-Report-to-Parliament-Meeting-Carbon-Budgets-Closing-the-policy-gap.pdf> [Checked 10/10/2018].

<sup>7</sup> European Parliament and the Council of the European Union (2014). Environmental Impact Assessment (EIA) Directive 85/337/EEC, [online]. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0052> [Checked 12/07/2018].

<sup>8</sup> The UK Government (2017). The Town and Country Planning (Environmental Impact Assessment) Regulations (2017), [online]. Available at: [https://www.legislation.gov.uk/uksi/2017/571/pdfs/uksi\\_20170571\\_en.pdf](https://www.legislation.gov.uk/uksi/2017/571/pdfs/uksi_20170571_en.pdf) [Checked 12/07/2018].

## Planning policy context

- 17.3.2 There are a number of policies and guidance documents at an international, national and local level that are relevant to this ES. In addition to policy referenced in **Chapter 5: Legislative and Policy Overview**, policy directly applicable to this technical specialism is listed in **Table 17.1**.

Table 17.1 Planning policy issues relevant to carbon and other GHGs

Policy reference	Implications
<b><i>The United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement<sup>9</sup></i></b>	
Article 2 Paragraph 1	The UNFCCC is the major international body responsible for managing climate change and carbon emissions. In 2015, it adopted the Paris Agreement, the aims of which are stated as: <i>"This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change; and (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production"</i> . The agreement sets targets for countries' GHG emissions, but these are not legally binding or enforceable. The agreement excludes international aviation (but domestic aviation is included).
<b><i>The Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England<sup>10</sup> (ANPS) (2018)</i></b>	
Paragraph 1.12	The ANPS outlines Government policy on climate change adaptation and GHG emissions into practice for Nationally Significant Infrastructure Projects (NSIPs). It is the basis for decision-making on Development Consent Order (DCO) applications for the Heathrow Expansion Programme (HEP). The policy states that <i>"The Airports NPS provides the primary basis for decision making on development consent applications for a Northwest Runway at Heathrow Airport, and will be an important and relevant consideration in respect of applications for new runway capacity and other airport infrastructure in London and the South East of England"</i> . Whilst the Proposed Development is not in the geographic location of the ANPS, the assessment of significance for aviation emissions considers the national context, and therefore the National Policy Statement (NPS) for the sector is of relevance.
Paragraph 1.14	The ANPS <i>"sets out planning policy in relation to applications for any airport nationally significant infrastructure project in the South East of England"</i> . Whilst the Proposed Development is not in the geographic location of the ANPS, the assessment of significance for aviation emissions considers the national context, and therefore the NPS for the sector is of relevance.
Paragraph 5.83	The ANPS states that the <i>"Secretary of State's view of the adequacy of [carbon and other GHGs] mitigation measures relating to the design, construction and operation phases will be a material factor in the decision-making process"</i> . Whilst the Proposed Development is not in the geographic location of the ANPS, the requirements for assessing carbon and other GHGs and the resultant mitigation is relevant.

<sup>9</sup> UNFCCC (2015). The Paris Agreement, [online]. Available at: <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement> [Checked 12/07/2018].

<sup>10</sup> Department for Transport (2018). Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England, [online]. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/714106/airports-nps-new-runway-capacity-and-infrastructure-at-airports-in-the-south-east-of-england-web-version.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714106/airports-nps-new-runway-capacity-and-infrastructure-at-airports-in-the-south-east-of-england-web-version.pdf) [Checked 12/07/2018].

Policy reference	Implications
<b>National Planning Policy Framework<sup>11</sup> (NPPF)</b>	
Paragraph 148	The NPPF acts as guidance for local planning authorities and decision-makers, both in drawing up plans and making decisions about planning applications. The 2018 revision of the NPPF states: <i>"The planning system should support the transition to a low carbon future in a changing climate... shape places in ways that contribute to radical reductions in greenhouse gas emissions... and support renewable and low carbon energy and associated infrastructure"</i> .
Paragraph 150	It also requires that new development should be planned for in ways that <i>"can help to reduce greenhouse gas emissions through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards"</i> .
Paragraph 153	Furthermore, it is stated that local planning authorities should expect new development to: <i>"a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption."</i>
<b>Aviation Policy Framework (APF) (2013)<sup>12</sup></b>	
Section 2	The APF presents the government's policy for aviation. This document postpones making a decision on whether the UK should retain a national emissions target for aviation. It also sets out the need to better understand and manage the risks associated with climate change. This was deemed essential for the successful long-term resilience of the UK's aviation industry and its contribution to supporting economic growth and competitiveness.
<b>Draft West of England Joint Spatial Plan (JSP)<sup>13</sup> (2017):</b>	
	The Draft JSP states that all new developments must <i>"minimise energy demand and maximise the use of renewable energy, where viable meeting all demands for heat and power without increasing carbon emissions"</i> . This includes a contribution to the use of low carbon energy in-line with objectives and provision of the <i>Climate Change Act 2008</i> and the 2050 Carbon neutral targets. The proposed vision for the West of England includes a statement that <i>"new development will be designed to be resilient to, and reduce the impacts of climate change"</i> . A combined CO <sub>2</sub> reduction of 50% by 2035 compared to the 2014 baseline is committed to.
<b>Climate Local North Somerset Council<sup>14</sup> (updated 2018<sup>15</sup>):</b>	
	<i>Climate Local for North Somerset</i> aims to reduce carbon emissions and increase resilience to climate change. The plan sets out commitments for Low Carbon Pathways and sets the carbon reduction target for the West of England local authorities of 50% by 2035 based on 2014 baselines, which is in-line with the draft West of England Joint Spatial Plan <sup>13</sup> .

<sup>11</sup> Department for Communities and Local Government (2018). National Planning Policy Framework (NPPF), [online]. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/733637/National\\_Planning\\_Policy\\_Framework\\_web\\_accessible\\_version.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733637/National_Planning_Policy_Framework_web_accessible_version.pdf) [Checked 21/08/2018].

<sup>12</sup> Department for Transport (2013). Aviation Policy Framework, [online]. Available at: <https://www.gov.uk/government/publications/aviation-policy-framework> [Checked 19/03/2018].

<sup>13</sup> West of England Partnership (2017). West of England Joint Spatial Plan (JSP) Publication Document 2017, [online]. Available at: <https://www.jointplanningwofe.org.uk/consult/ti/JSPPublication/consultationHome> [Checked 19/03/2018].

<sup>14</sup> North Somerset Council (2013). Climate Local North Somerset Council: Supporting growth, saving money and safeguarding communities, [online]. Available at: <https://www.n-somerset.gov.uk/wp-content/uploads/2016/01/climate-local-commitment.pdf> [Checked 30/04/2018].

<sup>15</sup> North Somerset Council, (2018). North Somerset climate Local Commitment Update Report 2018, [online]. Available at: <https://www.n-somerset.gov.uk/wp-content/uploads/2018/05/Climate-Local-Commitment-refresh-2018.pdf> [Checked 05/10/2018].

Policy reference	Implications
<b>International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)<sup>16</sup></b>	The ICAO is the delegated body for addressing requirements of the UNFCCC and the Paris Agreement with regards to aviation. 191 Member States agreed in 2016 to introduce a global market-based emissions offsetting scheme, known as CORSIA. The UK Government is a member of ICAO and signed up to CORSIA. The aim of CORSIA is to offset any growth from international aviation after 2020 within its scope. By 2035, 90% of international aviation activity will come under the scheme.
<b>European Union (EU) Emissions Trading Scheme<sup>17</sup> (ETS)</b>	The EU ETS is a cap-and-trade mechanism in which an allowance for annual carbon emissions from various sectors have been agreed at the EU level. The 2012 extension of EU ETS incorporated emissions from aviation flights to and from EU countries, although following appeal it only applies to domestic flights.

## Technical Guidance

17.3.3 **Table 17.2** lists guidance documents which are relevant to the baseline data collection and assessment of the effects on carbon and other GHG receptors.

Table 17.2 Technical guidance relevant to carbon and other GHGs

Guidance	Relevance						
<b>EIA Guidance</b>							
2017 Institute of Environmental Managers and Assessors (IEMA) guidance on <b>Assessing Greenhouse Gas Emissions and Evaluating their Significance</b> <sup>18</sup>	Provides guidance on assessment and mitigation of GHG emissions within an EIA context. Includes a focus on proportionate and robust assessment. The IEMA Guidance is based on the five IEMA Principles on Climate Change Mitigation and EIA. The way these principles have been treated in this assessment is described below.						
	<table> <tr> <th>IEMA Principle</th><th>Consideration in this assessment</th></tr> <tr> <td>The GHG emissions from all projects will contribute to climate change; the largest interrelated cumulative environmental effect.</td><td>The global atmosphere is the receptor for all GHG emissions in this assessment. All emissions to the atmosphere are considered negative, direct and permanent effects.</td></tr> <tr> <td>The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive – e.g. population, fauna, soil etc.</td><td>Projections of climate change are considered in <b>Chapter 10: Land Quality</b>, <b>Chapter 11: Biodiversity</b>, <b>Chapter 12: Surface Water and Flood Risk</b>, and <b>Chapter 13: Groundwater</b>.</td></tr> </table>	IEMA Principle	Consideration in this assessment	The GHG emissions from all projects will contribute to climate change; the largest interrelated cumulative environmental effect.	The global atmosphere is the receptor for all GHG emissions in this assessment. All emissions to the atmosphere are considered negative, direct and permanent effects.	The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive – e.g. population, fauna, soil etc.	Projections of climate change are considered in <b>Chapter 10: Land Quality</b> , <b>Chapter 11: Biodiversity</b> , <b>Chapter 12: Surface Water and Flood Risk</b> , and <b>Chapter 13: Groundwater</b> .
IEMA Principle	Consideration in this assessment						
The GHG emissions from all projects will contribute to climate change; the largest interrelated cumulative environmental effect.	The global atmosphere is the receptor for all GHG emissions in this assessment. All emissions to the atmosphere are considered negative, direct and permanent effects.						
The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive – e.g. population, fauna, soil etc.	Projections of climate change are considered in <b>Chapter 10: Land Quality</b> , <b>Chapter 11: Biodiversity</b> , <b>Chapter 12: Surface Water and Flood Risk</b> , and <b>Chapter 13: Groundwater</b> .						

<sup>16</sup> ICAO (2016). Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), [online]. Available at: <https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx> [Checked 10/10/2018].

<sup>17</sup> European Parliament and the Council of the European Union (2003). Establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (the EU Emissions Trading System), [online]. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0087&from=EN> [Checked 12/07/2018].

<sup>18</sup> IEMA (2017). Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance, [online]. Available at: [https://www.iaia.org/pdf/wab/EIA%20Guide\\_GHG%20Assessment%20and%20Significance\\_IEMA\\_16May17.pdf](https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf) [Checked 09/04/2018].

Guidance	Relevance
	<p>The UK has legally binding GHG reduction targets – EIA must therefore give due consideration to how a project will contribute to the achievement of these targets.</p> <p>Where available, the principles for meeting the UK Carbon Budget for each sector, alongside the current emissions from each sector, are used to contextualise the emissions from the Proposed Development in the assessment of significance. Construction does not have a Carbon Budget target, so the indicators for good practice in the UK Green Construction Board Low Carbon Routemap<sup>19</sup> are used to contextualise emissions for this sector. International aviation emissions are not included in the UK Carbon Budget at all, so the Committee on Climate Change's planning assumption of 37.5MtCO<sub>2</sub> by 2050<sup>22</sup> and the DfT aviation forecasts are used to contextualise the emissions from the Proposed Development.</p>
	<p>GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant.</p> <p>Whilst the global climate is considered a vulnerable receptor, and all emissions to the atmosphere are considered negative, direct and permanent effects, this assessment does not consider that all emissions are necessarily significant. The assessment instead assesses the extent to which the Proposed Development reduces the ability of the UK Carbon Budget to be met and requires satisfactory mitigations to be put in place to reduce emissions wherever practicable. This is considered a more proportionate response, as it enables an assessment of the magnitude of effect to be considered rather than assuming any emissions result in a significant effect.</p>
	<p>The EIA process should, at an early stage, influence the location and design of projects to optimise GHG performance and limit likely contribution to GHG emissions.</p> <p>The assessment of significance requires satisfactory mitigations to be put in place to reduce GHG emissions wherever possible in order to reduce the magnitude of effect and therefore be determined non-significant.</p>
<b>Carbon Management Standards</b>	
Publicly Available Standard (PAS) 2080: 2016 – <b>Carbon Management in Infrastructure</b> <sup>20</sup>	Provides an approach to management of reduction of GHG emissions from infrastructure projects, working with stakeholders throughout the project lifecycle.
<b>The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard</b> (GHG Protocol) <sup>21</sup>	Provides standards and guidance for preparing a GHG emissions inventory.
<p><sup>19</sup> The Green Construction Board, (2013). Low carbon routemap for the built environment, [online]. Available at: <a href="https://www.greenconstructionboard.org/index.php/resources/routemap">https://www.greenconstructionboard.org/index.php/resources/routemap</a> [Checked 09/04/2018].</p> <p><sup>20</sup> BSI, (2016). PAS 2080:2016. Carbon management in infrastructure.</p> <p><sup>21</sup> World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) (2014). The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard, March 2014, [online]. Available at: <a href="http://www.ghgprotocol.org/sites/default/files/ghgp/standards/ghg-protocol-revised.pdf">http://www.ghgprotocol.org/sites/default/files/ghgp/standards/ghg-protocol-revised.pdf</a> [Checked 09/04/2018].</p>	



Guidance	Relevance
<b>Clean Growth Strategy<sup>22</sup></b>	Provides the strategy for the UK's future clean growth to allow Carbon Budgets to be met and support economic growth. The strategy sets out policies and targets out to 2050 for reducing GHG emissions across a number of sectors.  The strategy focuses on accelerating clean growth, improving business and industry inefficiency, improving the energy efficiency of homes, rolling out low carbon heating, accelerating the shift to low carbon transport, delivering clean, smart, flexible power, enhancing the benefit and value of our natural resources and leading in the public sector and government.
<b>Aviation carbon guidance</b>	
The European Monitoring and Evaluation Programme (EMEP) / European Environment Agency (EEA) Guidebook <sup>23</sup>	The Guidebook provides guidance and data for the calculation of aviation emissions over the cruise <sup>24</sup> and Landing and Take Off <sup>25</sup> (LTO) phases. The EEA and the United Nations' Long-Range Transboundary Air Pollution (LRTAP) project produce the guidebook to support the compilation of greenhouse gas inventories across Europe and across market sectors. The aviation chapter of the guidebook recommends methodologies for calculating CO <sub>2</sub> emissions from aviation, with various 'tiers' or levels of accuracy. The Tier 3A approach shall be used by the assessment, since it provides the highest level of accuracy and is consistent with the forecast data available for the development.
<b>UK Aviation Forecasts (2017)<sup>26</sup></b>	With regards to Bristol Airport, the DfT's UK Aviation Forecasts states in Paragraph 5.46 that: <i>"the most significant changes in capacity input assumptions relate to the reduction in Bristol's terminal capacity from 12 million passengers per annum (mppa) to 10mppa in line with the current planning cap"</i> . Bristol Airport CO <sub>2</sub> emissions are stated as a maximum of 0.5Mt in the 2050s.
Royal Institution of Chartered Surveyors (RICS): <b>Methodology to calculate embodied carbon 1<sup>st</sup> edition<sup>27</sup></b>	The RICS guidance note represents best practice on how to estimate carbon emissions associated with product and construction process stages. The aim of the guidance is to provide a framework of practical guidance on how to calculate embodied carbon emissions associated with projects.

## 17.4 Data gathering methodology

### Study area

- 17.4.1 Carbon and other GHG sources have been considered for construction and operational activities from the Proposed Development. This includes the emissions resulting from activities within the application site (e.g. operation of the Proposed Development) and activities outside of the application site that are emitted as a direct result of the Proposed Development such as aviation emissions<sup>25</sup>, embodied carbon of materials used to construct the Proposed Development, and journeys to and from Bristol Airport.

<sup>22</sup> BEIS (2017). Clean Growth Strategy, [online]. Available at: <https://www.gov.uk/government/publications/clean-growth-strategy> [Checked 10/10/2018].

<sup>23</sup> European Environment Agency (2017). Emission Factor Database and EMEP/EEA air pollutant emission inventory guidebook – 2016, [online]. Available at: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/emission-factors-database> [Checked 09/04/2018].

<sup>24</sup> The Cruise phase for this scope constitutes climb from 3,000 ft (914m), cruise and descent to 3,000ft.

<sup>25</sup> The Landing and Take Off cycle accounts for aviation movements below 3,000ft.

<sup>26</sup> Department for Transport (2017). UK aviation forecasts, [online]. Available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/674749/uk-aviation-forecasts-2017.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/674749/uk-aviation-forecasts-2017.pdf) [Checked 09/04/2018].

<sup>27</sup> RICS (2014). Methodology to calculate embodied carbon 1<sup>st</sup> edition, [online]. Available at: [http://www.rics.org/Global/Methodology to calculate embodied carbon 1st edition PGguidance 2014.pdf](http://www.rics.org/Global/Methodology%20to%20calculate%20embodied%20carbon%201st%20edition%20PGguidance%202014.pdf) [Checked 21/08/2018].

- 17.4.2 Given the only receptor for GHG emissions is the global climate, the study area of the emissions from the Proposed Development is effectively the Earth system.

## Desk study

- 17.4.3 Information for the desk study has been sourced primarily from:
- Department for Business, Energy and Industrial Strategy (BEIS);
    - ▶ Baseline GHG emissions data for 1990-2016<sup>5</sup> has been sourced through the National Statistics service; and
    - ▶ Emissions factors for traffic and transport emissions have been sourced from the BEIS Greenhouse gas reporting conversion factors 2017<sup>28</sup>.
  - EMEP / EEA:
    - ▶ The EMEP/EEA Emission Factor Database<sup>23</sup> has been used as one of the main sources of data for aviation emissions associated with the Proposed Development.
  - International Civil Aviation Organisation (ICAO) Aircraft Engine Emissions:
    - ▶ The ICAO *Aircraft Engine Emissions Databank*<sup>29</sup> has been used as one of the main sources of data for aviation emissions associated with the Proposed Development.
  - Bristol Airport Limited (BAL):
    - ▶ Existing carbon reduction initiatives have been sourced from the Bristol Airport 2017 Operations Monitoring Report<sup>30</sup> and the ongoing development of mitigation to meet the Building Research Establishment Environmental Assessment Method (BREEAM) requirements.
  - University of Bath:
    - ▶ The *Inventory of Carbon & Energy* (ICE) database<sup>31</sup>, produced by the University of Bath and last updated in 2011, has been used to assess the embodied carbon of the Proposed Development based on material quantities.
- 17.4.4 There is also a number of datasets that have been collated/produced as part of this assessment. These are listed below and provided in **Appendix 17A**:
- Scope 1 (direct) and Scope 2 (indirect) emissions at Bristol Airport have been provided using the outputs of BAL's 2017 internal carbon audit for ACI Carbon Accreditation;
  - Building sizes, the GHG mitigation design features and the corresponding energy usage for future baseline and peak operation of the Proposed Development;
  - Bill of materials and the associated embodied carbon used in the construction of the Proposed Development;

<sup>28</sup> BEIS (2017). Greenhouse gas reporting: conversion factors 2017, [online]. Available at: <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017> [Checked 09/04/2018].

<sup>29</sup> ICAO (2017). ICAO Aircraft Engine Emissions Databank, [online]. Available at: <https://www.easa.europa.eu/easa-and-you/environment/icao-aircraft-engine-emissions-databank> [Checked 12/07/2018].

<sup>30</sup> Bristol Airport Limited (2018). 2017 Operations Monitoring Report, [online]. Available at: <https://www.bristolairport.co.uk/~media/files/brs/about-us/environment/2017-operations-monitoring-report-280618.ashx?la=en> [Check 1/10/2018].

<sup>31</sup> University of Bath (2008). Inventory of Carbon & Energy (ICE), [online]. Available at: <http://www.organicexplorer.co.nz/site/organicexplore/files/ICE%20Version%201.6a.pdf> [Checked 12/07/2018].



- Surface access forecasts, including number of employees onsite per day, passenger numbers, trip origins for employees and passengers accessing the airport by car and public transport, as detailed in the Transport Assessment (**Appendix 6A**);
- Number of surface access trips for delivery of construction materials;
- Air Traffic Movement forecast for future baseline and peak operation include LTO<sup>25</sup> and climb, cruise and descent (CCD)<sup>24</sup> phase forecast emissions of the Proposed Development; and
- Number of Full Time Employees (FTEs) for the construction employees required for the Proposed Development.

17.4.5 There is uncertainty regarding UK GHG policy in the aviation sector, which makes setting a definitive target against which to assess the likely significant effects challenging. Whilst the Committee on Climate Change (CCC) recommend a target of 37.5 million tonnes (Mt) CO<sub>2</sub> from the aviation sector by 2050 to Government<sup>32</sup>, this has not yet been brought into policy. The Clean Growth Strategy<sup>22</sup> suggests that the obligations under the *Climate Change Act*<sup>3</sup> can be met if aviation emissions are 44 MtCO<sub>2</sub>e by 2050<sup>26</sup>, which is based on the Airports Commission “carbon traded” scenario set out in 2015<sup>33</sup>. This figure is also used in the Department for Transport UK Aviation Forecasts 2017<sup>26</sup>. The UK Government’s paper<sup>34</sup> on next steps towards an aviation strategy sets out the position that the UK Government sees reducing aviation emissions as an international issue, and that cooperation across the global sector is required to reduce the impact on UK competitiveness.

## Survey work

17.4.6 No survey work has been necessary specifically for the assessment of effect on carbon and other GHG receptors, but the results of the traffic surveys described in the Transport Assessment (**Appendix 6A**) have been used in the assessment in this chapter.

## 17.5 Overall baseline

### Current baseline

#### Current baseline (application site)

17.5.1 2017 baseline emissions are presented in **Table 17.3**. These emissions represent the most up-to-date information available for GHG emissions at Bristol Airport.

Table 17.3 2017 baseline emissions

Source	Activity	CO <sub>2</sub> e (kt)/yr
Aviation	Cruise domestic	44.25 (ktCO <sub>2</sub> /yr)

<sup>32</sup> Committee on Climate Change (2009). Meeting the UK aviation target – options for reducing emissions to 2050, [online]. Available at: <https://www.theccc.org.uk/archive/aws2/Aviation%20Report%2009/21667B%20CCC%20Aviation%20AW%20COMP%20v8.pdf> [Checked 02/10/2018].

<sup>33</sup> Airports Commission (2015). Airports Commission: Final Report, [online]. Available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/440316/airports-commission-final-report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf) [Checked 09/04/2018].

<sup>34</sup> HM Government (2018). Beyond the horizon: The future of UK aviation, [online]. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/698247/next-steps-towards-an-aviation-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698247/next-steps-towards-an-aviation-strategy.pdf) [Checked 24/05/2018].

	Cruise international	586.36 (ktCO <sub>2</sub> /yr)
	LTO cycle domestic	18.83 (ktCO <sub>2</sub> /yr)
	LTO cycle international	97.33 (ktCO <sub>2</sub> /yr)
<b>Sub-total aviation</b>		<b>746.77 (ktCO<sub>2</sub>/yr)</b>
<b>Non-aviation Operations</b>	Scope 1 - Non-aviation operations (gas use, fleet vehicles, heating/red diesel, fire training, company cars, refrigerants)	<b>1.79</b>
	Scope 2 - Grid electricity	<b>4.63</b>
<b>Surface access</b>	Passengers	184.45
	Employees	7.44
<b>Sub-total surface access</b>		<b>191.89</b>
<b>Total all sources</b>		<b>945.08</b>

It should be noted that the aviation and surface access emissions form the Scope 3<sup>34</sup> emissions, however for the purposes of this assessment, have been reported separately.

- 17.5.2 Current baseline construction emissions associated with the Proposed Development are considered to be nil. Whilst construction occurred at Bristol Airport during 2017, it is a 'one-off' emissions source that relates to existing planning conditions and should therefore not be considered within this assessment.
- 17.5.3 Data has been gathered from the sources identified in **Section 17.4**. Scope 1 and 2 emissions and surface access emissions have been collated as part of this assessment and are provided in **Appendix 17A**.

### Current baseline (policy context)

- 17.5.4 UK GHG emissions from domestic and international aviation rose to a peak of 38Mt in 2006 and has since reduced to 35.5Mt in 2016<sup>32</sup>, the last year for which data is available.
- 17.5.5 Total GHG emissions reductions for the UK as a whole have met the requirements of the Second Carbon Budget<sup>5</sup>. However, most of the reduction has come in the power, industry and waste sectors, with transport increasing, largely as a result of rising demand for travel and a slowing of progress in improving the efficiency of vehicles. The UK Carbon Budgets include domestic aviation but not international aviation<sup>6</sup>.

### Future baseline

#### Future baseline (application site)

- 17.5.6 The future baseline emissions are presented in **Table 17.4**. The future baseline takes account of existing commitments to mitigate GHG emissions from operation whilst developing Bristol Airport to accommodate 10 mppa. Therefore, permitted developments at Bristol Airport that enable Bristol Airport to reach 10 mppa are considered in the future baseline.

Table 17.4 Future baseline emissions

Source	Activity	CO <sub>2</sub> e (kt/yr)
<b>Aviation</b>	Cruise domestic	42.80 ktCO <sub>2</sub> e/yr
	Cruise international	988.90 ktCO <sub>2</sub> /yr
	LTO cycle domestic	16.39
	LTO cycle international	135.79 ktCO <sub>2</sub> /yr
<b>Sub-total aviation</b>		<b>1,183.87 ktCO<sub>2</sub>/yr</b>
<b>Non-aviation operations</b>	Scope 1 - Non-aviation operations (gas use, fleet vehicles, heating/red diesel, fire training, company cars, refrigerants)	<b>2.21</b>
	Scope 2 - Grid electricity	<b>5.85</b>
<b>Surface access</b>	Passengers	214.23
	Employees	7.85
<b>Sub-total non-aviation operation</b>		<b>222.08</b>
<b>Total</b>		<b>1,414.01</b>

It should be noted that the aviation and surface access emissions form the Scope 3 emissions, however for the purposes of this assessment, have been reported separately.

- 17.5.7 Whilst construction may occur at Bristol Airport during the future baseline period, for each development it is a 'one-off' emissions source that relates to the planning conditions under which it has been approved and should therefore not be considered within this assessment.
- 17.5.8 Data has been gathered from the sources identified in **Section 17.4**. The data used to calculate the emissions for the future baseline are provided in **Appendix 17A**.

#### Future baseline (policy context)

- 17.5.9 Following the publication of *the Airports National Policy Statement*<sup>10</sup>, it is assumed that a runway expansion at a major airport in the south-east may take place, and that this can be achieved within the Government's carbon obligations of an 80% reduction in emissions by 2050. The Committee on Climate Change has set a recommended target of 37.5Mt CO<sub>2</sub> per annum<sup>32</sup> for emissions from aviation sources (i.e. not operational airport emissions), but this has not been brought into a government policy, and is therefore contextual. The BEIS *Clean Growth Strategy*<sup>22</sup> states a target of 44Mt CO<sub>2</sub> per annum in its 2050 pathways<sup>33</sup>, and the DfT Aviation Forecast<sup>26</sup> for a future in which Heathrow is expanded states a target of 44.1Mt CO<sub>2</sub>. This represents the "carbon traded" scenario set out by the Airports Commission in 2015<sup>33</sup>. There is therefore uncertainty in the future policy baseline for the assessment of significance of emissions from aviation sources from airports. The upcoming UK Aviation Strategy, expected in 2019, will provide greater clarity on UK aviation carbon policy and the associated targets.

- 17.5.10 Carbon Budgets for a range of sectors have been produced under the Fifth Carbon Budget<sup>35</sup>. Non-aviation sources of GHG emissions from the Proposed Development (e.g. buildings, transport) will be assessed in the context of these budgets.

## 17.6 Consultation

- 17.6.1 **Table 17.5** provides a summary of the issues raised by consultees and the response to these issues.

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<sup>35</sup> Committee on Climate Change (2015). Sectoral scenarios for the fifth carbon budget, [online]. Available at: <https://www.theccc.org.uk/publication/sectoral-scenarios-for-the-fifth-carbon-budget-technical-report/> [Checked 09/04/2018].

Table 17.5 Summary of issues raised during consultation regarding Carbon and Other GHG Emissions

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
1. The United Kingdom EIA Regulations (2017) which note that an EIA should identify, describe and assess the direct and indirect significant effects of a project on climate. This should include the assessment of the project effects on climate (e.g. GHG emissions), the interaction between climate and other factors (such as biodiversity, heritage, health, land, soil, water and air), in combination with the project and the vulnerability of the project to climate change and the impacts relevant to adaptation.	North Somerset Council (NSC)	This chapter describes and assesses the Proposed Development's effects on the global climate. The interaction between climate change other factors are considered in <b>Chapter 9: Landscape and Visual</b> , <b>Chapter 10: Land Quality</b> , <b>Chapter 11: Biodiversity</b> , <b>Chapter 12: Surface Water and Flood Risk</b> , and <b>Chapter 13: Groundwater</b> , rather than a standalone chapter. Climate change impacts on soil, heritage and health have been scoped out in <b>Section 10.6</b> , <b>Section 14.6</b> and <b>Section 16.6</b> , respectively. Matters concerning the vulnerability of the Proposed Development to climate change and adaptation are covered in <b>Section 2: Description of Development</b> .	<b>Section 9.6, 10.10, 11.10, 12.10 and 13.6</b>
2. The Institute for Environmental Management and Assessment (IEMA) EIA Guide to Climate Change Resilience and Adaptation (2015). It should be noted that this guidance is currently being reviewed and updated. Should this be available at the time of the ES, it should be included.	NSC	The updated <i>IEMA Guidance to Climate Change Resilience and Adaptation</i> was not available during the assessment of significant effects and has therefore not been considered as part of this assessment.	<b>N/A</b>
3. The Zone of Influence for GHG emissions is noted as the Earth system. Although it is recognized that GHG emissions can produce effects on a global scale, the assessment should focus on national, regional and local environments and how an increase in greenhouse gases may impact these (e.g. agricultural areas, habitats, etc.). This can be further detailed in relevant topic chapters, but it should be noted in this section.	NSC	For this chapter, the Zone of Influence (ZoI) is the Earth system as it is expressly concerned with the Proposed Development effects on the climate. Interactions between the Proposed Development and climate change are considered in other topic chapters, for which the ZoIs are often more localised. The ZoI of the vulnerability of the Proposed Development to climate change, as described in <b>Chapter 2: Description of the Proposed Development</b> , is the boundary of the Proposed Development.	<b>Section 17.7</b>
4. While the presented methodology and assessment of GHG emissions is acceptable, the calculated baseline greenhouse gases and	NSC	As set out in <b>Section 17.5</b> , "Carbon Budgets for a range of sectors have been produced under the Fifth Carbon Budget. Non-aviation sources of GHG emissions from the Proposed Development (e.g. buildings, transport) will be	<b>Section 17.5 and Section 17.10</b>

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
those associated with the development should be compared against the relevant UK Carbon Budgets, highlighting any increases that may impact on the ability of the government meeting its carbon reduction targets. This should be considered across all project phases, and opportunities identified to minimise the generation of greenhouse gases.		<i>assessed in the context of these budgets.”</i> and <b>Section 17.10</b> sets out the assessment findings including all phases of the Proposed Development.	
5. It is noted that potential receptors will include those that are scoped in for other topics, provided they have the potential to be impacted on by a climate hazard. In the ES, consideration for receptors throughout the project lifecycle should be given, this includes but not limited to construction (workforce, plant, machinery), Assets and their operation, maintenance and refurbishment and the end user (members of the public / passengers).	NSC	The assessment considers emissions from construction and operation (aviation and non-aviation) and surface access, including passenger access to Bristol Airport.	<b>Section 17.10</b>
6. The impacts on receptors should be identified using the latest climate projections data (currently UKCP09, as presented in the report). Reference is made to UKCP18, which is due to be released in November 2018. It is noted in the ES that this will not be available in time to inform the ES for the development. Should this change, UKCP18 should be used in place of UKCP09. The vulnerability of the project should be assessed in terms of both normal and extreme weather-related disaster scenarios throughout the project lifecycle.	NSC	UKCP18 was not available during the assessment of significant effects and has therefore not been considered as part of this assessment. The vulnerability of the Proposed Development to climate change and adaptation is covered in <b>Chapter 2: Description of the Proposed Development.</b>	<b>N/A</b>
7. It is noted that there will not be a separate chapter dealing with climate change in the ES, but rather the in-combination climate change impacts will be incorporated into relevant topic chapters and the climate change resilience	NSC	The updated <i>IEMA Guidance to Climate Change Resilience and Adaptation</i> was not available during the assessment of significant effects and has therefore not been considered as part of this assessment. The approach as set out in the scoping report has been followed for In-combination Climate Change Impacts,	<b>N/A</b>



Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
considerations into the design report. While it is noted that the current IEMA guidance on climate resilience does not give direction on how this should be approached, it is understood that the guidance is being reviewed. Depending upon when the planning application for 12mppa is submitted there may or may not be guidance published to inform whether Climate should form a separate chapter. BAL should review this matter.		and climate change resilience is described in <b>Section 2: Description of the Proposed Development</b> .	
8. It is noted that all assessments pertaining to identified impacts within relevant topics will be discussed in the topic chapters, which will include the impact of seasonal patterns on habitats (Biodiversity chapter). However, the interaction between climate change and land quality, socio-economics and GHG will not be further considered in the assessment, as it is noted that these topics are likely to have no impacts that can be affected by climate change. This should be reconsidered, as climate change have the potential to impact land quality and land use, with knock-on effects resulting in socio-economic impacts and GHG depending on the activity (i.e. additional power generation for cooling processes).	NSC	Interacting effects of the Proposed Development <i>and</i> climate change will be considered where there is the likelihood for a likely significant effect notwithstanding climate change. The impacts of climate change and the Proposed Development on land quality are considered, but the link between land quality and GHG through increases in power generation is not clear and is thus omitted. The impact of climate change altering requirements for cooling is considered in the design of the Proposed Development and therefore in the results described in <b>Section 17.10</b> , but this is not related to the land quality assessment for the Proposed Development.	<b>10.10 17.10</b>
9. Table 17.1 - Reference to local policy and the Climate Local Commitment – this needs to be updated to include the 2018 version, which now includes a carbon reduction target of 50% reduction in emissions by 2035 (from 2014 baseline): <a href="https://www.n-somerset.gov.uk/my-services/planning-building-control/planningpolicy/supplementary-planning-advice/guidance/climate-change/">https://www.n-somerset.gov.uk/my-services/planning-building-control/planningpolicy/supplementary-planning-advice/guidance/climate-change/</a>	NSC	The Climate Local Commitment as updated in 2018 is detailed in <b>Section 17.3</b> and has been used to inform this assessment.	<b>Section 17.3</b>

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
10. 17.5.8 – A reference should be provided to show where in the provisional GHG statistics, it says that the UK is on course to meet all carbon budgets and the 2050 target of an 80% reduction in emissions.	NSC	This statement was erroneous and has been clarified to relate to the Second Carbon Budget.	<b>Section 17.5</b>
11. 17.6.13 – UK Green Construction Board Low Carbon route map (2013) <sup>36</sup> contains quite a few out-of-date references e.g. Code for sustainable homes, Zero Carbon Homes and Green Deal. These should be updated.	NSC	The route map remains an appropriate comparator source for this assessment and will be used as best practice, where applicable. Any out of date references will be disregarded for the assessment.	N/A

<sup>36</sup> The Green Construction Board (2013). Low carbon routemap for the built environment, [online]. Available at: <https://www.greenconstructionboard.org/index.php/resources/routemap> [Checked 09/04/2018].

## 17.7 Scope of the assessment

### Spatial scope

- 17.7.1 Carbon and other GHG sources have been considered for construction and operational activities from the Proposed Development. This includes the emissions resulting from activities within the application site (e.g. operation of the Proposed Development) and activities outside of the application site that are emitted as a direct result of the Proposed Development such as aviation emissions<sup>25</sup>, embodied carbon of materials used to construct the Proposed Development, and journeys to and from the airport. Therefore, the spatial scope of the assessment of Carbon and Other GHG Emissions is the area of the Proposed Development as well as the extent of the cruise phase of departing flights, passenger, and surface access routes for employees and construction vehicles.
- 17.7.2 The receptor for the Carbon and Other GHG Emissions assessment is the global climate. There are no localised receptors.
- 17.7.3 Due to the small land take involved with the Proposed Development, land use changes as a result of the Proposed Development would have minimal effect on GHGs and are therefore not included.
- 17.7.4 Given the only receptor for GHG emissions is the global climate, the ZoI of the emissions from the Proposed Development is effectively global.

### Temporal scope

- 17.7.5 The temporal scope of the assessment of Carbon and Other GHG Emissions covers the construction and operational periods of the Proposed Development. Total emissions per annum associated with the operation of the Proposed Development at peak airport usage have been considered. Construction emissions have been estimated as a single value rather than per year.

### Potential receptors

- 17.7.6 Whilst there is only one receptor for the GHG assessment (the global climate), emissions from different sources have been considered individually, sources include: construction, non-aviation operations and aviation operations. The assessments have been carried out in relation to each source.

### Likely significant effects

- 17.7.7 The receptors that have been taken forward for assessment are summarised in **Table 17.6**.

Table 17.6 Carbon and Other GHG Emissions receptors scoped in for further assessment

Receptor	Relevant assessment criteria	Likely significant effects
<b>The global climate</b>	<p>IEMA 2017: <i>Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance</i><sup>18</sup> sets out that all emissions <i>might</i> be considered significant, and therefore mitigating action is required and should be considered when evaluating.</p>	<p>GHG emissions from constructing the Proposed Development.</p>

Receptor	Relevant assessment criteria	Likely significant effects
	<p>Expert judgement is used based on a worst-case quantification of GHG emissions and the extent to which the indicators for good practice contained within the <i>Green Construction Board Low Carbon Routemap</i><sup>19</sup> for the Built Environment have been applied through mitigation measures.</p> <p>Emissions to the global climate receptor are considered direct, negative and permanent in all cases.</p>	
<b>The global climate</b>	<p>IEMA 2017: <i>Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance</i><sup>18</sup> sets out that all emissions <i>might</i> be considered significant, and therefore mitigating action is required and should be considered when evaluating.</p> <p>Expert judgement is used based on a worst-case quantification of GHG emissions in comparison to the wider buildings and transport sectors, and the extent to which the mitigation in place to reduce emissions from non-aviation sources is suitable for the scale of the worst-case emissions predicted.</p> <p>Emissions to the global climate receptor are considered direct, negative and permanent in all cases.</p>	GHG emissions from non-aviation operation of the Proposed Development.
<b>The global climate</b>	<p>IEMA 2017: <i>Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance</i><sup>18</sup> sets out that all emissions <i>might</i> be considered significant, and therefore mitigating action is required and should be considered when evaluating.</p> <p>Expert judgement is used based on a worst-case quantification of GHG emissions in comparison to policy recommendations for aviation emissions and the scale of emissions in the context of the wider UK aviation sector.</p> <p>Emissions to the global climate receptor are considered direct, negative and permanent in all cases.</p>	GHG emissions from increases in aviation associated with the Proposed Development.

- 17.7.8 There are no other receptors for consideration, but it should be noted that emissions associated with land use change have not been calculated as part of the assessment as they are usually calculated on a national level, and changes in land use type associated with the Proposed Development would be minimal.

## 17.8 Environmental measures embedded into the development proposals

- 17.8.1 A range of environmental measures have been embedded into the development proposals as outlined in **Chapter 2: Description of the Proposed Development**, specifically **Section 2.3**.

17.8.2

**Table 17.7** outlines how these embedded measures have influenced the Carbon and Other GHG Emissions assessment. Note that surface access and construction measures have not been considered in the quantification of emissions but are considered within the assessment of significance. The increase in public transport share of surface access has been considered within the quantification of emissions, however the other embedded mitigations for surface access are only considered within the assessment of significance. Therefore, the total emissions quantified in **Section 17.10** are worst-case and will in reality be lower once the embedded measures are in place.

Table 17.7 Summary of the embedded environmental measures

Receptor	Changes and effects	Embedded measures
The global climate	Increase in GHG emissions from constructing the Proposed Development	<p>Measures to reduce GHGs in the construction phase have not been quantified in the assessment detailed in <b>Section 17.10</b>, which is therefore worst-case. However, a number of commitments have been made in the Construction Environmental Management Plan (CEMP) [<b>Appendix 2B</b>] to minimise energy use and GHG emissions. These are:</p> <ul style="list-style-type: none"> <li>● High efficiency HGVs;</li> <li>● High efficiency plant and building equipment;</li> <li>● Construction site connection to grid electricity to reduce use of mobile generation;</li> <li>● Carbon emissions reporting to target outstanding emissions sources and continually improve performance;</li> <li>● Construction plant switched off when not in use (no idling); and</li> <li>● Avoidance of waste to landfill wherever possible.</li> </ul>
		<p>There will be consideration of whole-life carbon in materials selection to reduce embodied carbon wherever possible. In line with targeted BREEAM credits, the final materials choice will be informed by <i>The Green Guide to Materials Specification</i> to encourage the use of construction materials with a low environmental impact (including embodied carbon) over the full life cycle of the Proposed Development.</p>
	Increase in non-aviation GHG emissions from operating the Proposed Development	<p>A combination of Combined Heat and Power (CHP), wind and PV will be utilised to provide 15% renewables on the estate. The Building Emission Rate (BER) will be reduced where ever commercially viable to the lowest values, making the renewables significantly more practical to deliver on the estate.</p>
		<p>Passive measures for operational energy reduction:</p> <ul style="list-style-type: none"> <li>● Minimise heat loss through efficient thermal envelope of the building; and</li> <li>● Use of natural daylight where possible in the building.</li> </ul> <p>Introduction of solar shading where appropriate to reduce heat gain causing additional cooling.</p> <p>Active measures for operational energy reduction:</p> <ul style="list-style-type: none"> <li>● Low energy building systems such as low energy HVAC systems, occupancy sensors and an integrated Building Management System (BMS) with the existing terminal infrastructure;</li> <li>● High efficacy lighting such as LED as standard;</li> <li>● Sub Metering for electricity, gas and water where appropriate linking with the integrated BMS;</li> <li>● Reporting of electricity, gas and water consumption aid efficiency reviews;</li> </ul>

- Automatic control of external lighting to prevent operation during daylight hours;
- Lifts, Escalators and Walkways have the facility to reduce energy consumption when not in use;
- Water metering built into the BMS, with reporting and efficiency campaigns to reduce consumption; and
- Reduce water consumption, through water efficient equipment: low volume dual flush toilets, urinals with proximity sensors, waterless urinals, taps with flow restrictors.

A series of measures that reduce GHG emissions associated with surface access to Bristol Airport have been identified in the Transport Assessment (**Appendix 6A**). They are:

- Increase in public transport share of surface access through the introduction of Bristol Flyer Service A2, increase in frequency of Weston Flyer Service A3 and additional first and last mile solutions;
- Walking and cycling access improvements through the upgrading of the A38/Downside Road junction to incorporate footway and cycleway facilities, additional cycle parking, E-bike loans and provision of shower facilities for employees;
- Public transport awareness building amongst employees, and provision of sustainable travel modes for travelling around Bristol Airport; and
- Internal lift share scheme, with an app and branded marketing materials.

These environmental measures have not been considered in the quantification of GHGs from surface access in **Section 17.10**, which are therefore worst-case.

Increase in aviation GHG emissions from operating the Proposed Development

As described in **Chapter 7: Noise and Vibration**, Bristol Airport is keeping the night movement quota count budgets and therefore incentivising quieter aircraft against a backdrop of an annual night movement limit of 4,000. Quieter aircraft also provide increased fuel efficiency and therefore will result in less GHG emissions per aircraft operating at BAL. This is reflected in the ATM forecast and therefore the quantification of GHGs in **Section 17.10**.

Bristol Airport is a member of Sustainable Aviation (SA) and is actively engaged to reduce associated emissions both locally and through the Sustainable Aviation CO<sub>2</sub> Road Map. It is not possible to estimate what the emissions reductions associated with this will be, and therefore this is not quantified in **Section 17.10**.

## 17.9 Assessment methodology

- 17.9.1 The generic project-wide approach to the assessment methodology is set out in **Chapter 4: Approach to Preparing the Environmental Statement**, and specifically in **Sections 4.5 to 4.7**. However, whilst this has informed the approach that has been used in this Carbon and Other GHG Emissions assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this Carbon and Other GHG Emissions assessment.
- 17.9.2 The receptor for each emissions source is the global climate. Given the global impacts of climate change and the globally-recognised requirement to limit GHG emissions to 2°C as laid out in the Paris Agreement<sup>9</sup>, the receptor is considered highly important and vulnerable. GHG emissions to the receptor are considered direct and negative, and the effects on the receptor are permanent.
- 17.9.3 The way in which this assessment considers the IEMA *EIA Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance*<sup>18</sup> is detailed in **Table 17.2**.



- 17.9.4 Total emissions per annum associated with the Proposed Development at peak airport usage have been estimated in this assessment in order to provide the worst-case effect on climate change.
- 17.9.5 Emissions from non-aviation sources are inevitably smaller than those from aviation sources but are more able to be controlled by the owner/operator during the construction and operation phases of the Proposed Development. BAL monitors its Scope 1 and 2 GHG emissions and reports them annually.
- 17.9.6 For the purposes of this assessment, emissions sources have been broken down into:
- Construction emissions (embodied carbon, construction traffic, on-site processes etc.);
  - Non-aviation operations (surface access (employees, passengers), Scope 1 energy use (gas use, fleet vehicles, heating/red diesel, fire training, company cars, refrigerants), and Scope 2 energy use (grid electricity)); and
  - Aviation emissions (LTO<sup>25</sup> and CCD<sup>24</sup>).
- 17.9.7 Emissions from each source are calculated using the data identified in **Section 17.4**.
- 17.9.8 Predictions for GHG emissions from operations sources for the Proposed Development have been calculated and assessed against the future baseline. Current and future baseline construction GHG emissions are considered to be nil.
- 17.9.9 There are currently no requirements to mitigate aviation emissions at Bristol Airport through offsetting schemes outside its boundary (e.g. peatland restoration, tree planting). It is expected that this will continue for the Proposed Development, so offsetting is not considered further in the Carbon and Other GHG Emissions assessment.
- 17.9.10 For each emissions source, significance is assessed based on expert judgement that each of the following tests are satisfied, or otherwise:
- The relative scale of GHG emissions in relation to the relevant sector and/or UK Carbon Budgets for the relevant sector (where available) is not so great that the ability of the UK to meet its overall Carbon Budget is unduly affected; and
  - Satisfactory mitigations being put in place to reduce GHG emissions wherever practicable which means that the Proposed Development adheres to the principles required to meet the UK Carbon Budgets in each sector and regional policies. Construction is not treated as a separate sector, so the UK Green Construction Board Low Carbon Routemap<sup>19</sup> indicators for capital carbon are used instead, as the vast majority of construction emissions come from this source.
- 17.9.11 Given that the receptor (the global climate) is deemed highly vulnerable, each of the above tests must be satisfied for the effect to be not significant.

### Methodology for determining the effect of constructing the Proposed Development on the global climate, including embodied carbon

- 17.9.12 For construction emissions, the cumulative emissions of processes up to handover of the construction project to the use stage are considered. This represents the sum of GHG emissions covering extraction of raw and primary materials and their manufacture and refinement into products and construction materials, the transport and supply logistics, and an estimation of the on-site construction processes.

- 17.9.13 Quantified embodied carbon estimates and the number of construction vehicle movements based on the quantity of construction materials have been produced as part of this ES and are provided in **Appendix 17A**.
- 17.9.14 The emissions factor used for the assessment for the construction vehicle movements is 0.87029 kgCO<sub>2</sub>e/km. This represents an average diesel HGV with an average load<sup>28</sup>. The emissions factor used for the assessment for the construction employee vehicle movements is 0.07159 KgCO<sub>2</sub>e/km. This represents an average petrol Light Duty Vehicle (LDV) with an average load<sup>28</sup>.
- 17.9.15 Energy use from on-site construction processes has been estimated as 4.5% of the emissions from embodied carbon, based on a recent case study on a complex building that is of comparable complexity to that required for the Proposed Development<sup>2</sup>. This is in lieu of more detailed recent information for construction processes on site or in the UK aviation sector. This figure is in the same region as an older dataset from the UK construction industry that states on-site operations as being 5.8% of the manufacture sub-sector in 2008<sup>37</sup>. Therefore, the energy use approximation used is deemed appropriate.
- 17.9.16 The overall methodology for the assessment of the construction of the Proposed Development is to quantify its GHG emissions and determine the extent to which the construction processes committed to are in-line with the UK Green Construction Board low carbon routemap<sup>19</sup> indicators for good practice in reducing carbon intensity of construction, which are:
- Promote and encourage carbon measurement;
  - Embed carbon into the design process; and
  - Encourage measuring and reporting of on-site carbon emissions.
- 17.9.17 The assessment is based on expert judgement as there is no agreed threshold for the scale of construction emissions that constitute significant consequence, or otherwise.

### Methodology for determining the effect of non-aviation emissions from operating the Proposed Development on the global climate

- 17.9.18 The approach to determining significance for non-aviation emissions associated with the Proposed Development is to make an expert judgement as to whether the GHG emissions reported are significant in relation to the UK-wide Carbon Budgets for buildings and transport<sup>4</sup>, as determined by the CCC, and then consider whether the embedded mitigation in place to reduce emissions from non-aviation sources are suitable for the scale of the worst-case emissions predicted. The scale of emissions in relation to regional totals are also considered.
- 17.9.19 The extent to which emissions are in-line with Policy Principle 5 (Mitigate and adapt to climate change and use a catchment based approach to water management) in the West of England JSP<sup>13</sup> and the approaches outlined for meeting Carbon Budgets by the CCC<sup>39</sup> have been considered.
- 17.9.20 The draft JSP<sup>13</sup> states that new developments must “*minimise energy demand and maximise the use of renewable energy, where viable meeting all demands for heat and power without increasing carbon emissions*”, in order to meet an overall regional CO<sub>2</sub> emissions reduction of 50% by 2035

<sup>37</sup> Department for Business Innovation and Skills (2010). Estimating the amount of CO<sub>2</sub> emissions that the construction industry can influence. Supporting material for the low carbon construction IGT report. Autumn 2010. [online]. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/31737/10-1316-estimating-co2-emissions-supporting-low-carbon-igt-report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/31737/10-1316-estimating-co2-emissions-supporting-low-carbon-igt-report.pdf) [Checked 09/10/2018].

from 2014 levels. The extent to which the Proposed Development is in-line with this statement is considered in the assessment using expert judgement.

- 17.9.21 The Joint Transport Strategy, produced as part of the JSP<sup>38</sup>, states two objectives relating to reducing carbon emissions: *"provide a transport network which is low carbon and resource efficient in operation"* and *"encourage low carbon travel choices"*. As a generator of road traffic, the extent to which the latter of these is facilitated by the Proposed Development is considered in the assessment using expert judgement. On the national scale, the Committee on Climate Change<sup>39</sup> states *"national and local policies to reduce demand"* as the core principle for reduced emissions that is relevant to the Proposed Development<sup>6</sup>.

### Assessment methodology for calculating Scope 1 and Scope 2 emissions

- 17.9.22 The increase in gas use, fleet vehicles, heating and refrigerants has been determined by scaling up the existing Scope 1 carbon footprint values to incorporate the new features of the airport. There will not be any increase in fire training or company cars associated with the Proposed Development, so these remain unchanged.
- 17.9.23 Energy use has been calculated using an estimate of the electricity and heating demand of the building types of the Proposed Development based on operational experience of the site. A measure of kWh/m<sup>2</sup> has been calculated for each component of the Proposed Development (as described in **Chapter 2: Description of the Proposed Development**) and is provided in **Appendix 17A**. Efficiency features of the new infrastructure have been considered within the assessment. The carbon intensity of UK grid electricity (gCO<sub>2</sub>e/kWh) depends on the projected rate of decarbonisation over time.

### Assessment methodology for calculating emissions from surface access

- 17.9.24 Surface access emissions have been calculated using employee and passenger numbers and by estimating the number of total kilometres travelled for each mode of transport, based on information from the Traffic Assessment (**Appendix 6A**) and provided in **Appendix 17A**. This has been multiplied by emissions factors from the 2017 conversion factors published by BEIS<sup>28</sup>.
- 17.9.25 The emissions factors used for the assessment are:
- Passenger vehicle (car, taxi): 0.29881 kgCO<sub>2</sub>e/km<sup>28</sup>; and
  - Local Bus: 0.12 kgCO<sub>2</sub>e/passenger.km<sup>28</sup>.

### Methodology for determining the effect of aviation emissions from operating the Proposed Development on the global climate

- 17.9.26 The majority of an airport's GHG emissions arise from the combustion of fuel by aircraft. Although research is being undertaken to introduce lower-carbon biofuels, it is likely that fuel will remain largely fossil-derived with only a fairly small percentage of biofuel in the mix over the timescale of this assessment. Aviation emissions sources are broken down into:
- CCD<sup>24</sup> phase (departure only to avoid double-counting with other airports); and
  - The LTO<sup>25</sup> cycle.

<sup>38</sup> West of England authorities (2017). West of England Joint Transport Study: Final Report, [online]. Available at: [https://www.jointplanningwofe.org.uk/gf2.ti/f/757442/31727173.1/PDF/-/JTS\\_Final\\_Report.pdf](https://www.jointplanningwofe.org.uk/gf2.ti/f/757442/31727173.1/PDF/-/JTS_Final_Report.pdf) [Checked 15/10/2018].

<sup>39</sup> Committee on Climate Change (2018). Reducing UK emissions: 2018 Progress Report to Parliament. [online]. Available at: <https://www.theccc.org.uk/publication/reducing-uk-emissions-2018-progress-report-to-parliament/> [Checked 15/10/2018].

- 17.9.27 In terms of air transport emissions, the UK policy position set out in **Section 17.3** is the following:
- International aviation emissions are excluded from the UK's climate change budgets<sup>6</sup>;
  - UK Government policy is to seek to manage international aviation emissions through international agreements, such as the ICAO agreement to stabilise international emissions from 2020 through the CORSIA agreement<sup>16</sup>;
  - Domestic aviation is included within the UK's climate change budgets<sup>6</sup>; and
  - Government will consider further the advice from the CCC on treatment of international aviation in the forthcoming Aviation Strategy<sup>34</sup>.
- 17.9.28 The assessment carried out to test the significance of the Proposed Development's aviation CO<sub>2</sub> emissions has therefore focused on two contexts:
- Comparing domestic aviation emissions from the Proposed Development flights to UK-wide domestic aviation emissions and setting international aviation emissions within the context of the UK aviation sector as a whole. In the absence of an agreed domestic aviation Carbon Budget, the assessment has examined any change in domestic aviation emissions from the Proposed Development against the most up-to-date Government reported domestic emissions of 1.62 MtCO<sub>2</sub> in 2050 (LHR extended northern runway, low scenario)<sup>26</sup>; and
  - Overall (domestic and international) aviation emissions associated with the Proposed Development have been considered in the context of a UK aviation industry that exists within an overall target of 80% reduction in total UK GHG emissions by 2050<sup>9</sup>. It should be noted that it has not been possible to prescribe a quantified level of aviation GHG emissions from the Proposed Development that would be significant or otherwise, due to the many variables that influence the satisfaction of the 80% emissions reduction target and any associated recommendations that UK aviation emissions in 2050 are kept to 2005 levels<sup>9</sup>. Therefore, expert judgement has been used to determine the extent to which increased aviation emissions associated with the Proposed Development are significant within the context of the wider UK aviation sector.
- 17.9.29 The relevant principle for meeting the UK Carbon Budget, as set out by the Committee on Climate Change, is *"a plan for UK aviation emissions at around 2005 levels by 2050"*. Therefore, the scale of aviation emissions within the context of the CCC planning assumption of 37.5MtCO<sub>2</sub> by 2050<sup>32</sup> is considered.

#### Assessment methodology for calculating emissions from CCD phase

- 17.9.30 The CCD<sup>24</sup> phase of flights has only been considered for departing flights, following DfT guidance<sup>26</sup>.
- 17.9.31 The calculation of aircraft CO<sub>2</sub> emissions used forecast one-week aircraft schedules for 10 mppa and 12 mppa scenarios as provided in **Appendix 17A**. The schedules include an arrival/departure flag, the aircraft type and the origin or destination of the flight. Arriving aircraft were not considered as part of the calculation of CCD<sup>24</sup> emissions. Because the schedules reflect a busy summer week rather than an average week, the number of movements in the schedule was adjusted so that the total number of movements over the course of a year was correct.

- 17.9.32 The schedules provide destination airports for departures. The coordinates (latitude/longitude) of each destination airport were obtained from publicly available databases<sup>40</sup> and cross-checked<sup>41 42</sup>. The great circle distance<sup>43</sup> (GCD) from Bristol Airport to each airport was calculated from the coordinate pairs using standard trigonometric formulae.
- 17.9.33 To account for the fact that aircraft often do not fly exact great circle routes, it is usual practice to uplift the great circle distance by a certain amount to obtain the actual flight distance. Various procedures for uplifting the GCD have been proposed. For the Proposed Development, the procedure recommended by DfT was used, namely uplifting the GCD by 5% for short-haul *"to reflect the latest evidence in inherent inefficiencies in air traffic control, flight paths and airspace"*<sup>26</sup>.
- 17.9.34 Emission factors were derived from the EMEP/EEA guidebook<sup>44</sup>, formerly known as CORINAIR. The EEA and the United Nations (UN's) Long-Range Transboundary Air Pollution project (LRTAP) produce the guidebook to support the compilation of GHG inventories across Europe and across market sectors. The aviation chapter of the guidebook<sup>44</sup> recommends methodologies for calculating GHG emissions from aviation, with various "tiers" or levels of accuracy. The Tier 3A approach has been used for this work, since it provides the best level of accuracy consistent with the availability of data. Specifically, it uses data on aircraft type and origin/destination.
- 17.9.35 The Tier 3A method takes into account that emission rates vary between phases of flight, and consequently that fuel burn is related to flight distance, but not in a simple way because different flight lengths entail different times in the various phases such as CCD<sup>24</sup>.
- 17.9.36 EMEP/EEA provides two spreadsheets for calculating emissions, one for the LTO phase<sup>45</sup> and one for the CCD phase<sup>46</sup>. The underlying methodologies behind these spreadsheets are briefly described in the main guidebook document<sup>44</sup>, with more detail available in a supporting document<sup>47</sup>. The spreadsheet embodies a set of factors derived by using Eurocontrol's Advanced Emissions Model (AEM) tool<sup>48</sup>. AEM uses a high level of four-dimensional<sup>49</sup> trajectory information to calculate fuel burn — a level of detail which is not generally available to the public, and in particular is not available for future movements.
- 17.9.37 Because aircraft types, engines, flight trajectories and so on evolve over time, AEM and the EMEP/EEA spreadsheets are updated periodically. For the present work, the latest available version of the EMEP/EEA spreadsheets was used, from 2016. The EMEP/EEA spreadsheets are based on the current (2016) aircraft fleet characteristics, so it is only able to calculate emissions for the most common existing aircraft types. Where a schedule has aircraft types which are not in the EMEP/EEA

<sup>40</sup> GitHub (2018). JSON database of 28k+ airports with ICAO/IATA codes, names, cities, two-letter country identifiers, elevation, latitude & longitude, and a timezone identifier, [online]. Available at: <https://github.com/mwgg/Airports> [Checked 05/10/2018].

<sup>41</sup> OpenFlights (2018). Airport database, [online]. Available at: <https://openflights.org/data.html> [Checked 05/10/2018].

<sup>42</sup> Arash Partow (2018). The Global Airport Database, [online]. Available at: <http://www.partow.net/miscellaneous/airportdatabase/> [Checked 05/10/2018].

<sup>43</sup> Great Circle Distance is the shortest distance between two points on the surface of a sphere measured along the surface of the sphere.

<sup>44</sup> EMEP/EEA air pollutant emission inventory guidebook (2016). Chapter 1.A.3.a Aviation, [online]. Available at: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2016> [Checked 31/03/2017].

<sup>45</sup> 1.A.3.a Aviation 2 LTO emissions calculator 2016.xlsm. At: 1.A.3.a Aviation – Annex 5 – LTO emissions calculator 2016 [online]. Available at: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-a-aviation/view> [Checked 31/03/2017].

<sup>46</sup> 1.A.3.a Aviation 1 Master emissions calculator 2016.xlsm. At: 1.A.3.a Aviation – Annex 5 – Master emission calculator 2016 [online]. Available at: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-a-aviation-1/view> [Checked 31/03/2017].

<sup>47</sup> EUROCONTROL (2016) EUROCONTROL method for estimating aviation fuel burnt and emissions in the framework of the EMEP/EEA air pollutant emission inventory guidebook 2016. June 2016.

<sup>48</sup> EUROCONTROL, (2018). Advanced Emissions Model (AEM).

<sup>49</sup> Three dimensions of space plus one of time.

list, it is necessary to use a surrogate aircraft type. This applies mainly to the Airbus A320neo and Boeing 737Max aircraft, for which the current A320ceo or 737-800 types are used as surrogates.

- 17.9.38 For aviation sources, only CO<sub>2</sub> emissions have been reported. This is consistent with the DfT UK Aviation Forecasts 2017<sup>26</sup>.

### Assessment methodology for calculating emissions from LTO cycle

- 17.9.39 The LTO<sup>25</sup> cycle is considered for all Air Traffic Movements (ATM)s that occur as a result of the Proposed Development. As is common practice, emissions are calculated for all parts of the LTO at Bristol Airport, including the arrival elements (approach, landing roll and taxi-in). This is a minor deviation from the formal recommendation to present emissions for departing flights only, as this would entail calculating the arrival LTOs at a large number of remote airports for which data collection would be extremely onerous.
- 17.9.40 As noted in paragraph 17.9.26, EMEP/EEA provides a spreadsheet for calculating emissions for the LTO phase, but this was not used for this assessment. A detailed emissions inventory was calculated using data specific to Bristol Airport, including detailed taxi-in and taxi-out times as described in Appendix 8D. This inventory included fuel consumption as an integral part of the calculation. LTO emissions of CO<sub>2</sub> were calculated by multiplying the fuel consumption by a factor of 3.15. This approach is considered to be more accurate than using a more generic approach such as the EMEP/EEA spreadsheet<sup>23</sup>.

## 17.10 Assessment of effects: the global climate

### Baseline conditions

#### Current baseline

- 17.10.1 Baseline emissions are presented in **Table 17.3**. These emissions represent the most up-to-date information available for GHG emissions at the airport.
- 17.10.2 Data has been gathered from the sources identified in **Section 17.4**. The data used to calculate the emissions for the future baseline are provided in **Appendix 17A**.
- 17.10.3 Total 2017 baseline emissions are 945.08 kt CO<sub>2</sub>e/yr.

#### Future baseline

- 17.10.4 The future baseline emissions are presented in **Table 17.4**. This future baseline includes existing commitments to mitigate GHG emissions from operation whilst developing Bristol Airport to accommodate 10 mppa.
- 17.10.5 Data has been gathered from the sources identified in **Section 17.4**. The data used to calculate the emissions for the future baseline are provided in **Appendix 17A**.
- 17.10.6 Total future baseline emissions are 1,414.01 kt CO<sub>2</sub>e.



## Predicted effects and their significance

### GHG emissions from constructing the Proposed Development

- 17.10.7 Estimated emissions from construction phase sources, using the methodologies described in **Section 17.9**, are shown in **Table 17.8**. This represents a worst-case scenario, as the measures described in **Table 17.7** have not been included in this quantification.

Table 17.8 Emissions from construction phase

Source	Activity	Proposed Development (12 mppa) (kt CO <sub>2</sub> e)
Construction	Construction vehicles (HGVs)	4.29
	Construction employee vehicles (LDVs)	0.62
	Embodied carbon of materials	41.32
	On-site construction processes	1.86
<b>Total construction</b>		<b>48.09</b>

- 17.10.8 The assumptions made as part of this assessment are:

- HGVs originate within 150km from Bristol;
- Construction employee numbers are based on direct jobs created in the North Somerset, West of England and South West & South Wales Region as a result of the Proposed Development from the economic impact assessment;
- Commuting distance was estimated using the average commuting distances based on the National Travel Survey<sup>50</sup>;
- Internal Doors, fittings, furnishing and equipment have not been included in the embodied carbon assessment since they are deemed to not be carbon critical elements; and
- Energy use from on-site construction processes has been estimated as 4.5% of the emissions from embodied carbon<sup>2</sup>.

- 17.10.9 The GHG emissions from constructing the Proposed Development are 48.09 ktCO<sub>2</sub>e.

- 17.10.10 Construction emissions are inevitably relatively small in relation to the sector as a whole and cannot be said to have a substantial impact on meeting UK Carbon Budgets across sectors<sup>51</sup>. Given that there is no threshold for the scale of construction emissions that constitute significant consequence or otherwise, the significance of GHG emissions from constructing the Proposed Development primarily depends on the extent to which the construction process is commensurate with national scale strategies to reduce emissions from construction. The UK Green Construction Board Low

<sup>50</sup> The UK Government (2017). National Travel Survey: 2017 tables. [online]. Available at: <https://www.gov.uk/government/statistics/national-travel-survey-2017> [Checked 13/09/2018].

<sup>51</sup> Construction is not considered as a sector in the UK Carbon Budgets but is instead taken into account as a factor across a range of sectors.

Carbon Routemap<sup>19</sup> sets out key progress indicators for capital carbon, of which the following are relevant at the scale of the Proposed Development:

- Promote and encourage carbon measurement;
- Embed carbon into the design process; and
- Encourage measuring and reporting of on-site carbon emissions.

17.10.11 The measures embedded into the construction of the Proposed Development, as set out in **Section 17.8**, describe best practice and enable the reduction of emissions where practicable. The measures embedded in the CEMP [**Appendix 2B**] and committed to in the Carbon and Climate Change Action Plan which would follow approval for 12 mppa provide the requisite level of detail to ensure that the mitigation measures are secured and achievable. As a result, the effects of constructing the Proposed Development on the global climate are considered **not significant**.

### GHG emissions from operating the Proposed Development

17.10.12 GHG emissions as a result of the operation of the Proposed Development are described here. This includes both non-aviation and aviation emissions.

17.10.13 The estimated emissions from operational phase sources, using the methodologies described in **Section 17.9**, are shown in **Table 17.9**. This represents a worst-case scenario, as not all of the mitigation measures described in **Table 17.7** can be quantified and are thus not reflected in the reported GHG emissions. Where they have not been quantified, this is described in **Table 17.7** and **Table 17.11**.

Table 17.9 Operational emissions

Source	Activity	Future baseline (10 mppa) (ktCO <sub>2</sub> e / yr unless stated otherwise)	Proposed Development (12 mppa) (ktCO <sub>2</sub> e / yr unless stated otherwise)	Emissions associated with the Proposed Development (ktCO <sub>2</sub> e/yr unless stated otherwise)
Non-aviation operations	Scope 1	2.21	2.65	0.44
	Scope 2	5.85	7.26	1.41
	Surface access	222.08	267.94	45.86
<b>Sub-total non-aviation operations</b>		<b>230.14</b>	<b>277.85</b>	<b>47.71</b>
Aviation operations	Cruise domestic	42.80 (ktCO <sub>2</sub> /yr)	46.53 (ktCO <sub>2</sub> /yr)	3.73 (ktCO <sub>2</sub> /yr)
	Cruise international	988.90 (ktCO <sub>2</sub> /yr)	1075.01 (ktCO <sub>2</sub> /yr)	86.11 (ktCO <sub>2</sub> /yr)
	LTO cycle domestic	16.39 (ktCO <sub>2</sub> /yr)	17.53 (ktCO <sub>2</sub> /yr)	1.14 (ktCO <sub>2</sub> /yr)
	LTO cycle international	135.79 (ktCO <sub>2</sub> /yr)	151.38 (ktCO <sub>2</sub> /yr)	15.60 (ktCO <sub>2</sub> /yr)
<b>Sub-total aviation operations</b>		<b>1,183.87 ktCO<sub>2</sub>/yr</b>	<b>1,290.46 ktCO<sub>2</sub>/yr</b>	<b>106.59 ktCO<sub>2</sub>/yr</b>

Source	Activity	Future baseline (10 mppa) (ktCO <sub>2</sub> e / yr unless stated otherwise)	Proposed Development (12 mppa) (ktCO <sub>2</sub> e / yr unless stated otherwise)	Emissions associated with the Proposed Development (ktCO <sub>2</sub> e/yr unless stated otherwise)
Total		1,414.01ktCO <sub>2</sub> /yr	1,568.31 ktCO <sub>2</sub> /yr <sup>52</sup>	154.30 ktCO <sub>2</sub> /yr

- 17.10.14 Data has been gathered from the sources identified in **Section 17.4**. Emission data that has been collated and produced as part of this assessment and are provided in **Appendix 17A**.
- 17.10.15 The overall worst-case increase in GHG emissions from operating the Proposed Development are 154.30 ktCO<sub>2</sub>e/yr.
- 17.10.16 Worst-case increase in Scope 1 emissions of 0.44 ktCO<sub>2</sub>e from the Proposed Development are relatively minor within the scale of the non-residential UK buildings sector total of 22Mt CO<sub>2</sub> from direct emissions in 2016<sup>6</sup> (0.002%). Similarly, worst-case increase in Scope 2 emissions of 1.41 ktCO<sub>2</sub>e is relatively minor within the scale of the 52Mt CO<sub>2</sub>e from indirect emissions from UK buildings in 2016<sup>6</sup> (0.003%). Emissions from industry and commercial electricity, gas and other fuel use in the west of England were 1.4Mt CO<sub>2</sub> in 2016<sup>53</sup> (0.1%). Therefore, emissions from the Proposed Development cannot be considered to have a substantial influence on the reductions necessary in the buildings sector to meet the UK Carbon Budgets and are relatively small in relation to total regional emissions.
- 17.10.17 The assessment of significance of effect is therefore dependent on the CO<sub>2</sub> mitigation embedded within the Proposed Development being in-line with recommendations for the sector to meet the UK Carbon Budget and regional policy principles. They are:
- All new buildings highly efficient from outset and low-carbon heat ready (Committee on Climate Change<sup>39</sup>, 2017); and
  - Minimise energy demand and maximise the use of renewable energy, where viable meeting all demands for heat and power without increasing carbon emissions (Draft JSP<sup>13</sup>, 2017).
- 17.10.18 The measures embedded into the design of the Proposed Development, as set out in **Table 17.7**, describe best practice and enable the reduction of emissions where practicable. In particular, the use of CHP, wind and PV to deliver 15% renewable energy for the Airport shows commitment to these principles. The commitments made in the **Chapter 2: Description of the Proposed Development** and the Design and Access Statement provide the requisite level of detail and assurance to ensure that the mitigation measures are secured and achievable. The measures described in **Table 17.7** are deemed to meet national and local policy requirements.
- 17.10.19 Worst-case increase in surface access emissions of 47.68 ktCO<sub>2</sub>e/yr as a result of the Proposed Development and are relatively minor within the scale of total UK road transport emissions of 114.2 MtCO<sub>2</sub>e in 2016<sup>5</sup> (0.04%), and regional west of England transport emissions of 1.4 MtCO<sub>2</sub><sup>53</sup> (3.2%). Therefore, emissions from the Proposed Development cannot be considered to have a substantial influence on the reductions necessary in the transport sector to meet the UK Carbon Budgets and

<sup>52</sup> ktCO<sub>2</sub> is shown for the total rather than ktCO<sub>2</sub>e in order to show the worst case. Aviation emissions, which make up the majority of total emissions, are only available in CO<sub>2</sub> rather than CO<sub>2</sub>e.

<sup>53</sup> BEIS (2018). UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2016, [online]. Available at: <https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2016>. [Check 15/10/2018].

are relatively small in relation to total regional emissions given the nature of the airport as a transport hub.

- 17.10.20 The assessment of significance of effect is therefore dependent on the CO<sub>2</sub> mitigation measures embedded within the Proposed Development being in-line recommendations for the sector to meet the UK Carbon Budget and regional policy principles. They are:
- Local policies to reduce car travel demand (Committee on Climate Change<sup>39</sup>, 2017); and
  - Encourage low carbon travel choices (Draft JSP<sup>13</sup>, 2017).
- 17.10.21 The measures embedded into the design of the Proposed Development relating to the Transport Assessment (**Appendix 6A**), as set out in **Table 17.7**, will be secured through a Section 106 agreement. Increasing public transport share and reducing single occupancy car journeys will be achieved through the introduction of new bus routes and improvement of those that already exist. Walking and cycling access improvement, public transport awareness schemes for employees and an internal lift share scheme are also embedded into the Proposed Development through the Transport Assessment (**Appendix 6A**).
- 17.10.22 As a result of the measures in place to reduce non-aviation operational emissions being in-line with the principles for meeting the UK Carbon Budgets as set out by the Committee on Climate Change<sup>39</sup> and the regional policies in the draft West of England JSP<sup>13</sup>, the effects of non-aviation operation of the Proposed Development on the global climate are considered **not significant**.
- 17.10.23 Increase in total aviation emissions of 106.59 ktCO<sub>2</sub>/yr is relatively minor within the scale of both the CCC recommendation of 37.5 MtCO<sub>2</sub>/yr<sup>32</sup> and the DfT forecast of 44 MtCO<sub>2</sub>/yr for 2050<sup>26</sup>, at 0.28% and 0.24% respectively. In the absence of an agreed domestic aviation Carbon Budget, the assessment has examined any change in domestic aviation emissions from the Proposed Development against the most up-to-date Government reported domestic emissions of 1.62 MtCO<sub>2</sub>/yr for 2050<sup>26</sup>. Increase in domestic aviation emissions of 4.87 ktCO<sub>2</sub>/yr is therefore relatively minor within the scale of the DfT domestic aviation forecast of 1.62 MtCO<sub>2</sub>/yr for 2050, at 0.3%. The increase in domestic aviation emissions from the Proposed Development are infinitesimal in the context of the fifth Carbon Budget for the UK of 345 MtCO<sub>2</sub>e/yr for the period 2028 to 2032 (the most distant to be agreed)<sup>5</sup>, at 0.001%. The Proposed Development can therefore not be considered to have a substantial impact on UK GHG emissions to be at 2005 levels by 2050, as recommended by the CCC<sup>6</sup>.
- 17.10.24 As described in **Chapter 7: Noise and Vibration**, the airport is keeping the night movement quota count budgets as they stand today and therefore incentivising quieter aircraft against a backdrop of an annual night movement limit of 4,000. Quieter aircraft also provide increased fuel efficiency and therefore will result in less GHG emissions per aircraft operating at BAL. This is reflected in the ATM forecast and therefore the quantification of GHGs in **Section 17.10**.
- 17.10.25 Bristol Airport is a member of Sustainable Aviation (SA) and is actively engaged to reduce associated emissions both locally and through the Sustainable Aviation CO<sub>2</sub> Road Map. It is not possible to estimate what the emissions reductions associated with this will be, and therefore this is not quantified in the quantification of GHGs. However, as set out in the UK Government's paper<sup>54</sup> on next steps towards an aviation strategy, reducing aviation emissions is an international issue, so the extent of BAL's influence on aviation emissions is clearly limited. The core mechanism for

<sup>54</sup> HM Government (2018). Beyond the horizon: The future of UK aviation, [online]. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/698247/next-steps-towards-an-aviation-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698247/next-steps-towards-an-aviation-strategy.pdf) [Checked 24/05/2018].

international action is CORSIA<sup>16</sup>, a global market-based emissions offsetting scheme, which aims to maintain CO<sub>2</sub> emissions from international flights at 2020 levels.

- 17.10.26 As a result of the small scale of increased emissions in relation to the UK aviation sector, the relatively small impact on the ability of the UK to meet the 37.5MtCO<sub>2</sub> planning assumption<sup>32</sup>, and embedded mitigations applied where practicable, the effect of aviation emissions from the Proposed Development are considered **not significant**.

## 17.11 Consideration of optional additional mitigation or compensation

- 17.11.1 No additional mitigation measures are proposed to further reduce the Carbon and other GHG effects that are identified in this ES. This is because all relevant and implementable measures have been embedded into the development proposals and are considered in the assessment of significance (but not all have been considered in the quantifications, as described in **Section 17.8**). These measures are considered likely to be effective and deliverable and address the likely significant effects of the project on the global climate.

## 17.12 Conclusions of significance evaluation

- 17.12.1 **Table 17.10** sets out the significance of each emissions source based on the tests described in **Section 17.8**.

Table 10 Summary of conclusions of significance

Emissions source	Relative scale of emissions	Adherence to regional policy and the principles identified by the CCC to meet the UK Carbon Budget through mitigations to reduce GHG where practicable.	Significance
<b>Construction</b>	N/A (no GHG emissions totals for the UK construction sector are available).  Construction emissions are inevitably relatively small in relation to the sector as a whole and cannot be said to have a substantial impact on meeting UK Carbon Budgets across sectors. The measures embedded into the construction of the Proposed Development, as set out in <b>Section 17.8</b> , describe best practice and enable the reduction of emissions where practicable.	<p><b>Principles, policies and indicators:</b></p> <ul style="list-style-type: none"> <li>Promote and encourage carbon measurement;</li> <li>Embed carbon into the design process; and</li> <li>Encourage measuring and reporting of on-site carbon emissions (all (UK Green Construction Board, 2013).</li> </ul> <p><b>Mitigations in place:</b></p> <p>Measurement and reporting of GHG emissions on the construction site have been committed to through the CEMP (<b>Appendix 2B</b>). Carbon has been embedded into the design process through measures placed in the CEMP and through targeting BREEAM credits for materials selection that reduce embodied carbon wherever possible.</p> <p>Further mitigations for reducing emissions on site have been committed to in the CEMP (<b>Appendix 2B</b>) and Carbon and Climate Change Action Plan, as listed in <b>Table 17.7</b>.</p>	<b>Not significant</b>
<b>Non-aviation operation</b>	Total on-site GHG emissions represent 0.1% of west of England emissions from industrial and commercial electricity, gas and other fuel use.	<p><b>Principles, policies and indicators:</b></p> <ul style="list-style-type: none"> <li>All new buildings highly efficient from outset and low-carbon heat</li> </ul>	<b>Not significant</b>

Emissions source	Relative scale of emissions	Adherence to regional policy and the principles identified by the CCC to meet the UK Carbon Budget through mitigations to reduce GHG where practicable.	Significance
	<p>Scope 1 GHG emissions represent 0.002% of the UK non-residential buildings direct emissions total in 2016.</p> <p>Scope 2 GHG emissions represent 0.003% of the UK buildings indirect emissions total in 2016.</p> <p>Scope 1 &amp; 2 emissions from the Proposed Development cannot be considered to have a substantial influence on the reductions necessary in the buildings sector to meet the UK Carbon Budgets and are relatively small in relation to total regional emissions.</p> <p>Surface access GHG emissions represent 3.2% of the total west of England transport emissions in 2016, and 0.04% of the total UK transport emissions in 2016. Emissions from the Proposed Development cannot be considered to have a substantial influence on the reductions necessary in the transport sector to meet the UK Carbon Budgets and are relatively small in relation to total regional emissions given the nature of the airport as a transport hub.</p>	<p>ready (Committee on Climate Change<sup>39,9</sup>, 2018);</p> <ul style="list-style-type: none"> <li>Minimise energy demand and maximise the use of renewable energy, where viable meeting all demands for heat and power without increasing carbon emissions (Draft JSP<sup>13</sup>, 2017);</li> <li>Local policies to reduce car travel demand (Committee on Climate Change<sup>39</sup>, 2018); and</li> <li>Encourage low carbon travel choices (Draft JSP<sup>13</sup>, 2017).</li> </ul> <p><b>Mitigations in place:</b></p> <p>All new buildings associated with the Proposed Development are designed to be highly efficient given the mitigations described in the DAS.</p> <p>A combination CHP, wind and PV will be utilised to provide 15% renewables on the estate. The BER (Building Emission Rate) will be reduced where ever commercially viable to the lowest values, making the renewables significantly more practical to deliver on the estate</p> <p>A series of active and passive measures to reduce energy produced during operation have been committed to through the DAS.</p> <p>A series of measures to minimise GHG emissions associated with surface access to the Proposed Development have been committed to through the Transport Assessment, including increased public transport options, walking and cycling access improvements, public transport awareness for all employees, and an internal lift share scheme.</p> <p>Further mitigations to reduce GHGs at Bristol Airport as a whole will be developed through the production of a Carbon and Climate Change Action Plan following approval for the Proposed Development.</p>	
<b>Aviation</b>	<p>Total aviation GHG emissions represent 0.28% of the CCC recommendation for 2050, and 0.24% of the DfT forecast for 2050.</p> <p>Domestic aviation GHG emissions represent 0.3% of the DfT domestic aviation forecast for 2050, which is 0.001% of the total Fifth Carbon Budget for the UK (covering 2028 to 2032).</p> <p>The Proposed Development can therefore not be considered to have a substantial impact on UK</p>	<p><b>Principles, policies and indicators:</b></p> <ul style="list-style-type: none"> <li>A plan for UK aviation emissions at around 2005 levels by 2050 (Committee on Climate Change<sup>39</sup>, 2017).</li> </ul> <p><b>Mitigations in place:</b></p> <p>The Proposed Development represents 0.28% of the CCC recommendation for emissions from the UK aviation sector in 2050. Quieter and therefore more efficient aircraft that emit less GHG emissions per Air Traffic Movement</p>	<b>Not significant</b>

Emissions source	Relative scale of emissions	Adherence to regional policy and the principles identified by the CCC to meet the UK Carbon Budget through mitigations to reduce GHG where practicable.	Significance
	GHG emissions to be at 2005 levels by 2050, as recommended by the CCC <sup>6</sup> .	(ATM) are incentivised by night movement quota budgets remaining static.	

## 17.13 Implementation of environmental measures

17.13.1 **Table 17.8** describes the environmental measures embedded within the Proposed Development and the means by which they will be implemented.

Table 17.11 Summary of environmental measures to be implemented – relating to Carbon and other greenhouse gases

Environmental measure	Responsibility for implementation	Compliance mechanism	ES section reference
<b>A range of measures to minimise energy use and GHG emissions during the construction of the Proposed Development.</b>	Developer/Contractor	CEMP ( <b>Appendix 2B</b> ) and Carbon and Climate Change Action Plan (Section 106 agreement)	<b>Section 17.8</b>
<b>Consideration of whole-life carbon in materials selection to reduce embodied carbon wherever possible.</b>	Developer	CEMP ( <b>Appendix 2B</b> ) and Carbon and Climate Change Action Plan (Section 106 agreement)	<b>Section 17.8</b>
<b>A combination CHP, wind and PV will be utilised to provide 15% renewables on the estate. The BER (Building Emission Rate) will be reduced where ever commercially viable to the lowest values, making the renewables significantly more practical to deliver on the estate</b>	Developer	DAS	<b>Section 17.8</b>
<b>A range of passive measures to minimise energy use and GHG emissions during the operation of the Proposed Development, as listed in Table 17.7.</b>	Developer / Contractor	DAS	<b>Section 7.8</b>
<b>A range of active measures to minimise energy use and GHG emissions during the operation of the Proposed Development, as listed in Table 17.7.</b>	Develop / contractor	DAS	<b>Section 17.8</b>
<b>A range of measures to minimise GHG emissions associated with surface access to the Proposed Development, including increased public transport, walking and cycling access improvements, public transport awareness for employees, and an internal lift share scheme.</b>	Developer	Transport Assessment (Section 106 agreement)	<b>Section 17.8</b>

Environmental measure	Responsibility for implementation	Compliance mechanism	ES section reference
<b>Commitment to develop a Carbon and Climate Change Action Plan for Bristol Airport following approval for the Proposed Development</b>	Developer	Planning condition	N/A
<b>Quieter and therefore more efficient aircraft that emit less GHG emissions per Air Traffic Movement (ATM)</b>	Developer	<b>Chapter 7: Noise and Vibration</b>	<b>Section 17.8</b>